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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : G08C 17/00

A1

(11) International Publication Number: WO 94/02920

(43) International Publication Date: 3 February 1994 (03.02.94)

(21) International Application Number: PCT/IT93/00080

(22) International Filing Date: 22 July 1993 (22.07.93)

(30) Priority data:
RM92A000568 24 July 1992 (24.07.92) IT

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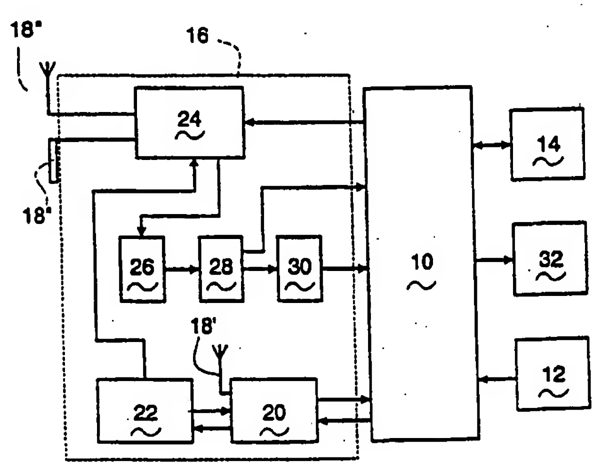
(81) Designated States: AU, BB, BG, BR, BY, CA, CZ, FI, HU, JP, KP, KR, KZ, LK, MG, MN, MW, NO, NZ, PL, RO, RU, SD, SK, UA, US, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: REMOTE CONTROLLER USING ELECTROMAGNETIC WAVES WITH AUTOMATIC LEARNING FUNCTIONS



(57) Abstract

There is described a remote controller using electromagnetic waves with automatic learning functions, characterised in that it comprises in combination: a radio-frequency unit (16) provided with at least one receiving device and one transmitting device and connected to at least one receiving and transmitting aerial (18); a microprocessor unit (10) connected to the said radio-frequency unit (16) so that it can receive data from it and send to it command signals and data to be transmitted; a memory (14) for the storage of the data; and a keypad (12) by means of which the user sends the operating commands to the microprocessor (10), the arrangement being such that, when a learning key is pressed for the emulation of an original remote controller, the microprocessor (10) prepares the receiving device of the radio-frequency unit (16) for operation, analyses the data received from it, varies its operating parameters until it identifies the operating parameters of the original remote controller, and stores in the memory (14) the operating parameters thus identified, while, when a key is pressed to remotely control the controlled equipment, the microprocessor (10) retrieves from the memory (14) the previously stored operating parameters and, by means of these, prepares for operation and activates the transmitting device of the radio-frequency unit (16).

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Description

Remote controller using electromagnetic waves with automatic learning functions

The present invention relates to a remote controller of the type capable of interacting with the remotely controlled equipment through electromagnetic waves in the radio-frequency range, for example a remote controller for a gate opener, a door opener, or for a burglar alarm system for a motor car or for the home, provided with automatic learning devices to analyse and store the operating parameters of the original remote controller supplied with the remotely controlled equipment.

The growth in demand for theft prevention devices and the increased interest in automatic devices controlled at a distance by remote controllers have led to the installation of large numbers of devices of the remotely controlled type, making it necessary to provide additional remote controllers either as supplementary devices when more than one remote controller is required for each piece of equipment, for example when more than one person uses the same equipment, or as spares in the case of failure or breakage.

However, since each individual piece of equipment requires its own remote controller with an individual code, the remote controllers in use hitherto have certain disadvantages, the main disadvantage being that it is necessary for the installers of remotely controlled equipment or for retailers of spares to hold a vast quantity of different remote controllers in stock, one for each type of equipment handled, and to execute personalisation procedures with each installation or replacement.

Similarly, the individual user has to own, and consequently carry with him, several remote controllers, one for each piece of equipment to be used, for example one for the car alarm, one for the gate opener or garage opener, one for the home burglar alarm, and so on.

Moreover, the user generally has to apply to the installer, thus incurring corresponding costs in terms of time and money, to obtain a duplicate of a remote controller when another person is to be enabled to use the remotely controlled equipment.

The principal object of the present invention is therefore to provide a remote controller using electromagnetic waves with automatic learning functions capable of analysing and emulating at least one remote controller originally supplied with a remotely controlled piece of equipment.

Another object of the present invention is to provide a remote controller using electromagnetic waves with automatic learning functions having means of storing the parameters for the emulation of many different remote controllers, and consequently capable of replacing, by itself, all these emulated remote controllers.

Another object of the present invention is to provide a remote controller using electromagnetic waves with automatic learning functions the use of which is simple and immediate.

A further object of the present invention is to provide a remote controller using electromagnetic waves with automatic learning functions having a simple and economical structure suitable for mass production.

According to the present invention, a remote controller using electromagnetic waves with automatic learning functions is characterised in that it comprises in combination: a radio-frequency unit provided with at least one receiving device and one transmitting device and connected to at least one receiving and transmitting aerial; a microprocessor unit connected to the said radio-frequency unit so that it can receive data from it and send to it command signals and data to be transmitted; a memory for the storage of the data; and a keypad by means of which the user sends the operating commands to the microprocessor, the arrangement being such that, when a learning key is pressed for the emulation of an original remote controller, the microprocessor prepares the receiving device of the radio-frequency unit for operation, analyses the data received from it, varies its operating parameters until it identifies the operating parameters of the original remote controller, and stores in the memory the operating parameters thus identified, while, when a key is pressed to remotely control the controlled equipment, the microprocessor retrieves from the memory the previously stored operating parameters and, by means of these, prepares for operation and activates the transmitting device of the radio-frequency unit.

The principal advantage of the remote controller according to the present invention lies in the fact that the operation of duplication of a single remote controller becomes extremely simple and may therefore be executed by the user without the intervention of the installer.

In this way, the user is enabled in a simple and economical way to have the desired number of remote controllers for the same equipment.

According to another aspect of the present invention, a single remote controller may be provided with means for the analysis and storage of many sets of operating parameters corresponding to different remote controllers, and

means for the transmission of a command signal taken from each set of operating parameters separately.

For example, the keypad may comprise a number of keys, the pressing of at least one of which, during the learning phase, is associated with the storage of a set of parameters relating to an original remote controller different from that with which at least one other key is associated, while, during the transmission phase, it is associated with the transmission of a command signal for the controlled equipment, the signal being obtained from the set of parameters separately associated with this particular key.

A further advantage of the present remote controller, when made according to the last mentioned aspect of the invention, consists in the fact that it becomes possible for the user to own and to carry with him a single remote controller with which he can operate various pieces of radio-controlled equipment without the necessity of having with him a separate remote controller for each piece of equipment to be remotely controlled, as has been the case hitherto.

The present invention will be further explained in the following text, and other advantages will be made clear by the description of a practical embodiment of the remote controller using electromagnetic waves with automatic learning functions according to the present invention, the description being given by way of example on a purely illustrative and non-limiting basis, with reference to the attached drawings, in which:

Figure 1 is an outline block diagram of the electronic circuit of the remote controller using electromagnetic waves according to the present invention;

Figure 2 is a complete block diagram of the electronic circuit of the currently preferred embodiment of the remote controller according to the present invention;

Figure 3 shows the detailed electrical circuit of the remote controller in Figure 2; and

Figures 4a and 4b in combination form a flowchart which may be used to explain more clearly the operation of the present remote controller.

With reference to the attached drawings, and in particular to the outline block diagram in Figure 1, it will be seen that a remote controller using electromagnetic waves with automatic learning functions according to the present invention comprises a microprocessor 10 which is connected to a keypad 12 through which it receives the commands entered by the user and which operates by retrieving program code from a memory 14 and by

exchanging data with the memory. The memory 14 may be located inside the microprocessor itself, instead of being external to the microprocessor, depending on the microprocessor used and the quantity of data to be stored.

The microprocessor 10 is also connected to a radio-frequency unit 16 which in turn is connected to a receiving and transmitting aerial 18.

The radio-frequency unit 16 comprises internally at least one receiving device to receive the signals transmitted by the original remote controller which is to be emulated, and to send data relating to it to the microprocessor 10, and also a transmitting device to transmit, during the phase of emulation of the original remote controller, a command signal reconstructed from the stored operating parameters.

In operation, when the present remote controller is to be prepared for the emulation of the original remote controller supplied with the remotely controlled equipment, the user presses the corresponding key on the keypad 12. Having received this command through the keypad 12, the microprocessor 10 sends suitable commands to the radio-frequency unit 16, these commands being such as to prepare the receiving device for operation so that it receives the command signal of the original transmitter, analyses the data received from the receiving device and varies the operating parameters of the receiving device until it identifies the operating parameters of the original remote controller. The microprocessor 10 thus analyses the transmission frequency and the modulation code and stores all the data relating to the signal or operating parameters of the original remote controller in the memory 14. The memory 14 is preferably of the non-volatile type.

Subsequently, when the present remote controller is to be used to operate the remotely controlled equipment, following the pressing by the user of the corresponding key on the keypad 12, the microprocessor 10 retrieves from the memory 14 the previously stored operating parameters of the remote controller to be emulated, and prepares the radio-frequency unit 16 for operation: using the operating parameters retrieved from the memory, the microprocessor 10 activates the transmitting device of the radio-frequency unit 16 in such a way as to make it transmit from the aerial 18 the command signal of the emulated remote controller.

Naturally certain precautions must be taken to prevent fraudulent use of the remote controller according to the present invention during the learning phase, to prevent the user from emulating a remote controller which he does not own by capturing its operating parameters without the knowledge of its legitimate owner. One or more of the measures described below may be taken

for this purpose.

A first measure of a general nature consists in the use, in the radio-frequency unit, of a receiving device having low sensitivity, possibly provided with a low-gain aerial. In this case the original remote controller and the remote controller according to the present invention must be very close during the learning phase, and it will not generally be possible to execute the learning operation out of sight of the owner of the original remote controller.

A second measure is to require a fairly long period, of the order of several tens of seconds for example, of activation of the original remote controller, so that automatic learning cannot be executed during the normal use of the original remote controller, since the latter is generally activated for a much shorter time, for example for a few seconds only.

A third measure consists in requiring confirmation of the parameters before storage, for example by requesting, by means of the illumination or flashing of a light-emitting diode, a second activation of the original remote controller after a certain time interval following the first activation, which evidently cannot be done if the original remote controller is not in the user's possession.

If the keypad 12 comprises more than two keys, it will obviously be possible not only to store a number of functions from a single original remote controller, but also to store the operating parameters of more than one original remote controller, and consequently it will be possible to use the present remote controller in place of a number of original remote controllers, with evident advantages arising from the necessity of carrying only one remote controller instead of a number of them.

Passing on to the description of the practical embodiment of the remote controller according to the present invention as shown in the complete block diagram in Figure 2, it should first be pointed out that currently used remote controllers using electromagnetic waves operate substantially in two frequency bands: the first band contains the frequencies from 26 to 34 MHz and the second band contains the frequencies from 260 to 400 MHz.

Thus, as shown in greater detail in Figure 2, the radio-frequency unit 16 comprises a frequency synthesiser 20, whose prescaler input is connected directly to a low-gain receiving aerial 18' for the reasons of security described previously, and whose command input is controlled directly by the microprocessor 10 which sets its operating frequency.

The frequency synthesiser 20 also directly controls a voltage-controlled oscillator (V.C.O.) 22 through a synchronising circuit of the PLL (phase-

locked loop) type contained in the said frequency synthesiser 20, which continuously checks and corrects the oscillation frequency of the oscillator 22.

For the transmission of the command signal for the activation of the remotely controlled equipment, the remote controller in Figure 2 makes use of a final power transmitting device 24, controlled directly by the oscillator 22 and switched to transmit directly by the microprocessor 10, in the radio-frequency unit 16. For the transmission of the command signals, the final power transmitting device 24 makes use of a ferrite transmitting aerial 18'' in the low frequency range (26-34 MHz) and a high-gain transmitting aerial 18''' in the high frequency range (260-400 MHz).

During the learning phase for the emulation of a remote controller, the final power transmitting device 24 is switched by the microprocessor 10 so that it operates as a radio-frequency aerial tuner, and its output, together with the output of the oscillator 22, is connected to a mixer unit 26, after which the signal passes to an intermediate-frequency amplifier and amplitude demodulator unit 28.

The output of the amplitude demodulator is connected to the microprocessor 10, while the output of the intermediate-frequency amplifier is also connected to a frequency demodulator unit 30. The output of the frequency demodulator unit 30 is connected directly to the microprocessor 10, which in this way detects, at different ports, the passage of the frequency of the local oscillator in the vicinity of the frequency of the signal received at the aerial, and also detects the demodulated signal which represents the code for the activation of the remotely controlled equipment.

One or more light-emitting diodes (LEDs) 32 are also provided for the communication of information to the user, for example to request the repetition of the operation of the original remote controller during the learning phase, or to confirm that storage has taken place.

With reference to Figure 3, the detailed electrical circuit of the currently preferred embodiment of the present remote controller using electromagnetic waves with automatic learning functions will now be described.

The circuit diagram in Figure 3 shows the blocks corresponding to the block diagram in Figure 2.

The variable-frequency voltage-controlled oscillator 22 comprises, in practice, two transistors, Q3 and Q4, to cover the two ranges envisaged for the present remote controller. More precisely, Q3 is used for the low range from 26 to 34 MHz, while Q4 is used for the high range from 220 to 440 MHz.

The embodiment using two separate oscillator transistors instead of one with switched reactances is more economical and compact in practice in view of the spacing of the ranges to be covered and the difference in levels required by the present application. However, the embodiment with a single oscillating transistor and switched reactances may obviously be used if preferable for any reason.

As may be seen clearly in the circuit diagram in Figure 3, the two oscillators are of the same type, and the differences consist solely in the different dimensions of the reactive components, in the different polarisations, and, obviously, in the different types of transistors; a valid description may therefore be provided with reference to only one of the oscillators.

The resistors R26, R27, R28 and their homologues R31, R32, R29 provide a high degree of stability at the initial operating point of the transistors Q3 and Q4 respectively, while the capacitor C26 and its homologue C32 short-circuit the bases of the transistors Q3 and Q4 respectively for the radio frequency.

The tuned circuit which determines the oscillation frequency of the transistors Q3 and Q4 principally consists of the components L3, C22 and the varicap diode D12, which constitutes the variable reactance for the transistor Q3, and consists of L5, C29 and D13 for the transistor Q4.

The positive reaction necessary to sustain the permanent oscillations is supplied through a reactive transformer comprising the capacitors C23 and C25 for the transistor Q3 and C30 and C31 for the transistor Q4; owing to the limited value of the reactance of such transformers with respect to the principal reactance, they have no practical effect on the oscillation frequency.

A low-pass filter consisting of the components R25 and C24 for the transistor Q3, and R30 and C28 for the transistor Q4, enables the varicap diode to be polarised, blocking the passage of the radio frequency along the frequency control line, indicated by FC in Figure 3.

The voltage-controlled oscillator 22 is coupled through C21 and L4, which form a high-pass filter for the output of the HF oscillator constructed around the transistor Q3 and a low-pass filter for the output of the oscillator LF constructed around the transistor Q4 respectively, to the final power amplifier 24 and the radio-frequency input of the frequency synthesiser 20, formed by using a PLL integrated circuit of the MC44802 type. The resistor R24 is a level control element for the radio-frequency input signal of the frequency synthesiser 20.

The final power amplifier 24, with the corresponding aerials 18" and

18''', uses a transistor Q2 as the active component. During the transmission phase, the resistors R33, R8 and R9 polarise the transistor Q2 to make it operate as a class C amplifier. The aerials are formed by the following tuned circuits: L2, C10, D4 for the low range, and L3, C7, D3 for the high range.

During transmission in the low range, the reactances L3, C7, D3 have a negligible effect, while the capacitor C8, through the radio-frequency switching diode D15, short-circuits L1 during transmission in the high band.

The varicap diodes D3 and D4 are polarised through R10 and R11 respectively, by the same line which polarises the varicap diodes D12 and D13 of the oscillators, and in this way the varicap diodes D3 and D4 tune the output circuits to the frequency of the oscillators.

During the reception phase the gain of the transistor Q2 is reduced drastically by reducing its polarisation, and the reduced signal from one of the oscillators is present at its collector together with any useful signal picked up from the corresponding tuned circuit.

The mixer 26 consists of a radio-frequency diode D2 and the resistors for the polarisation and centring of the swing of the following intermediate-frequency amplifier of the unit 28. It receives at its input both signals, that generated by the oscillator and that obtained up from the tuned circuit and supplies at its output the beat frequency which is sent to the unit 28.

In the unit 28, the intermediate-frequency amplifier and amplitude demodulator consists of an operational amplifier IC1/B with the network R4, R5, C3, C4 which limits the band width to 1 MHz about the central value of 4 MHz. The amplitude demodulator or detector uses a diode D1 and the filter network C2, R37, R3, C33.

A second operational amplifier IC1/A is used as a linear amplifier during the half-period in which the negative half-wave is present at the point A, while, during the positive half-wave, it is put into the low saturated state by the diode D14. In this way a kind of phase discriminator is formed, which, together with the ceramic filter Y1, which has a phase difference of 90° at the central frequency, forms a frequency discriminator of what is known as the quadrature type.

The filter consisting of the components R1, C1, R34 attenuates the mean-frequency products towards the input port of the microprocessor 10.

The operation of the currently preferred embodiment, the electrical circuit of which is shown in Figure 3, of the remote controller using electromagnetic waves with automatic learning functions according to the present invention will now be described with reference to the flowchart in

Figures 4a and 4b.

When all the keys are released, the present remote controller, as seen more clearly in the diagram in Figure 3, is not supplied with current, and is consequently in the state of maximum energy saving, the energy being supplied by electrical batteries as is usual for remote controllers of this type.

When any of the keys available to the user is pressed, power is supplied to the remote controller, and the microprocessor 10 begins to operate, causing initialisation of the remote controller.

The microprocessor 10 then determines which key has been pressed, and, if it is different from the learning key, enters the phase of emulation of the original remote controller supplied with the equipment to be remotely controlled. The microprocessor 10 first checks that there are valid parameters associated with this key, for example because the key has been used previously to store the operating parameters, in other words the data required by the microprocessor 10 to cause the remote controller to operate in emulation of a specific original remote controller supplied with the equipment to be remotely controlled.

If valid parameters are found in the memory, the microprocessor 10 retrieves the operating parameters of the remote controller to be emulated from the non-volatile memory 14.

On the basis of these data, the microprocessor 10 selects a transmission band and frequency, activating the oscillator Q3 or Q4 through one of the ports B1 or B0 respectively of the frequency synthesiser 20 and setting its operating frequency. Having set the operating frequency of the transistor Q3 or Q4 through the frequency synthesiser 20 and having activated the HF or LF oscillator through the port B1 or B0 of the synthesiser 20, the microprocessor 10 modulates the output of the final power amplifier 24 through its port PA2.

When the key is subsequently released, the power supply to the remote controller is cut off and the operation therefore ceases.

If, however, during the initial phase of operation, it is found that the learning key S5 has been depressed, the microprocessor 10 is forced to execute the operations required to detect and measure the operating parameters of a remote controller to be emulated, and to store the data relating to these parameters in the non-volatile memory 14.

During this learning phase, the microprocessor 10 causes the LED 32 to flash rapidly, to indicate to the user that the present remote controller is waiting to receive the signal transmitted from the original remote controller.

The microprocessor 10 then sets its port PA6 and the frequency synthesiser 20 so that the low-gain aerial 18' is connected to the input of the prescaler and the output B5 of the prescaler is sent to the port PA5 of the microprocessor 10. The microprocessor 10 then monitors the output of the prescaler to identify the presence of the signal from the original remote controller.

When the user has pressed the activation key of the original remote controller, the microprocessor 10 executes an approximate count of the output signal from the prescaler of the frequency synthesiser 20, in order to identify the transmission band of the original remote controller. When this band has been identified, the microprocessor 10 sets the PLL of the frequency synthesiser 20 to the start of the identified band, turns on the HF or LF oscillator which operates in this band, and scans the band with frequency increments of 0.5 MHz until an amplitude modulation is detected.

It then proceeds with increments, for example, of 1 kHz, if the low band (26-34 MHz) is being searched, or of 10 kHz, if the high band (260-400 MHz) is being searched. At the same time, the output of the discriminator 30 is monitored, and the scanning is stopped when the frequency of the synthesiser 20 coincides with the transmission frequency of the original remote controller. The microprocessor 10 then stores the parameter relating to the transmission frequency of the original remote controller in the non-volatile memory, and then analyses, by means of the AM detector 28, the code of the message transmitted by the original remote controller and stores the parameters relating to the code of this message in the non-volatile memory 14.

To indicate the successful outcome of the learning operation, the microprocessor 10 causes the LED 32 to flash slowly, whereas it keeps the LED 32 constantly illuminated in case of error, for example if the end of the searched band is reached or if the width of the AM detector range is exceeded without identification of the transmission frequency of the original remote controller.

If the learning operation has been successful, the microprocessor 10 waits for a certain time interval, for example five seconds, and then repeats the analysis of the code of the message received. If this message is the same, within certain well-defined tolerances, as the one stored previously, thus indicating that the user has continued to press the key of the original remote controller, the microprocessor 10 causes the LED 32 to flash rapidly, thus requesting the user to press the key with which the detected parameters are to be associated, and, when this information has been obtained, associates it with the parameters written to the non-volatile memory 14. If the message is

found to be different, the microprocessor 10 keeps the LED 32 constantly illuminated, thus indicating that an error has occurred; in this case, the whole learning procedure is cancelled.

When the key is subsequently released, the power supply to the present remote controller is cut off, and the data stored in the non-volatile memory 14 remain available for subsequent activations of the present remote controller.

Naturally, an indicator of any type, whether optical or of another kind, for example of the acoustic type, may be used in place of the indicator LEDs 32.

Although only one preferred embodiment of the remote controller using electromagnetic waves with automatic learning functions has been specifically illustrated and described herein, it is to be understood that minor variations may be made in the construction thereof without departing from the spirit and scope of the invention as defined by the appended claims.

Claims

1. Remote controller using electromagnetic waves with automatic learning functions, characterised in that it comprises in combination: a radio-frequency unit (16) provided with at least one receiving device and one transmitting device and connected to at least one receiving and transmitting aerial (18); a microprocessor unit (10) connected to the said radio-frequency unit (16) so that it can receive data from it and send to it command signals and data to be transmitted; a memory (14) for the storage of the data; and a keypad (12) by means of which the user sends the operating commands to the microprocessor (10), the arrangement being such that, when a learning key is pressed for the emulation of an original remote controller, the microprocessor (10) prepares the receiving device of the radio-frequency unit (16) for operation, analyses the data received from it, varies its operating parameters until it identifies the operating parameters of the original remote controller, and stores in the memory (14) the operating parameters thus identified, while, when a key is pressed to remotely control the controlled equipment, the microprocessor (10) retrieves from the memory (14) the previously stored operating parameters and, by means of these, prepares for operation and activates the transmitting device of the radio-frequency unit (16).

2. Remote controller according to Claim 1, characterised in that the said keypad (12) comprises a number of keys, the pressing of at least one of which, during the learning phase, is associated with the storage of a set of parameters relating to an original remote controller different from that with which at least one other key is associated, while, during the transmission phase, it is associated with the transmission of a command signal for the controlled equipment, the signal being obtained from the set of parameters separately associated with this particular key.

3. Remote controller according to Claim 1 or 2, characterised in that the said radio-frequency unit (16) comprises a frequency synthesiser (20), whose prescaler input is connected to a receiving aerial (18') and whose prescaler output is connected to an input port of the said microprocessor (10), under the control of the microprocessor (10) itself, the arrangement being such that the approximate counting of the prescaler output signal executed by the microprocessor (10) enables the transmission band of the original remote controller to be identified.

4. Remote controller according to Claim 3, characterised in that

the said frequency synthesiser (20) also controls a voltage-controlled oscillator (22) through a PLL synchronisation circuit contained within it.

5. Remote controller according to Claim 4, characterised in that the said variable-frequency voltage-controlled oscillator (22) comprises one or more oscillator transistors, one for each frequency band, each oscillator transistor being activated separately by the said microprocessor (10).

6. Remote controller according to Claim 4, characterised in that the said variable-frequency voltage-controlled oscillator (22) comprises a single oscillator transistor provided with a number of switchable reactance units, one for each frequency band.

7. Remote controller according to any of Claims 4 to 6, characterised in that the said radio-frequency unit (16) comprises a final power transmitting device (24), which is controlled by the oscillator (22) and switched to transmit by the microprocessor (10), and whose output controls a ferrite transmitting aerial (18") in the low-frequency range and a high-gain transmitting aerial (18"') in the high-frequency range.

8. Remote controller according to Claim 7, characterised in that, during the learning phase for the emulation of an original remote controller, the final power transmitting device (24) is switched by the microprocessor (10) so that it operates as an aerial tuner, and its output, together with the output of the oscillator (22), is connected to a mixer unit (26), after which the signal passes to an intermediate-frequency amplifier and amplitude demodulator unit (28), the output of the amplitude demodulator being connected to the said microprocessor (10), while the output of the intermediate-frequency amplifier is then connected to a frequency demodulator unit (30) whose output is connected to the said microprocessor (10).

9. Remote controller according to any of the preceding claims, characterised in that the said receiving device of the said radio-frequency unit (16) has low sensitivity.

10. Remote controller according to any of the preceding claims, characterised in that the said receiving device of the said radio-frequency unit (16) is provided with a low-gain aerial (18) or aerials (18', 18", 18"').

11. Remote controller according to any of the preceding claims, characterised in that means are provided which ensure that, during the learning phase, the original remote controller must be activated for a period much longer than the normal activation period.

12. Remote controller according to any of the preceding claims, characterised in that means are provided which ensure that, during the

learning phase, the original remote controller must be activated for a second time to enable the detected parameters to be confirmed.

13. Remote controller according to any of the preceding claims, characterised in that the said memory (14) is of the non-volatile type.

14. Remote controller according to any of the preceding claims, characterised in that an indicating device is provided for the communication of information to the user.

15. Remote controller according to Claim 14, characterised in that the said indicating device for the communication of information to the user consists of a light-emitting diode (32).

16. Remote controller according to Claim 14, characterised in that the said indicating device for the communication of information to the user consists of a number of light-emitting diodes (32).

17. Remote controller according to Claim 14, characterised in that the said indicating device for the communication of information to the user consists of an acoustic device.

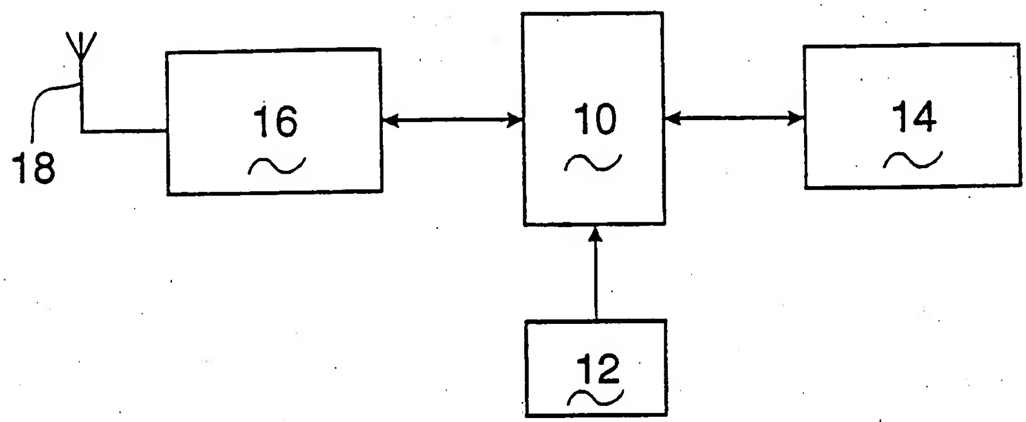

FIG. 1

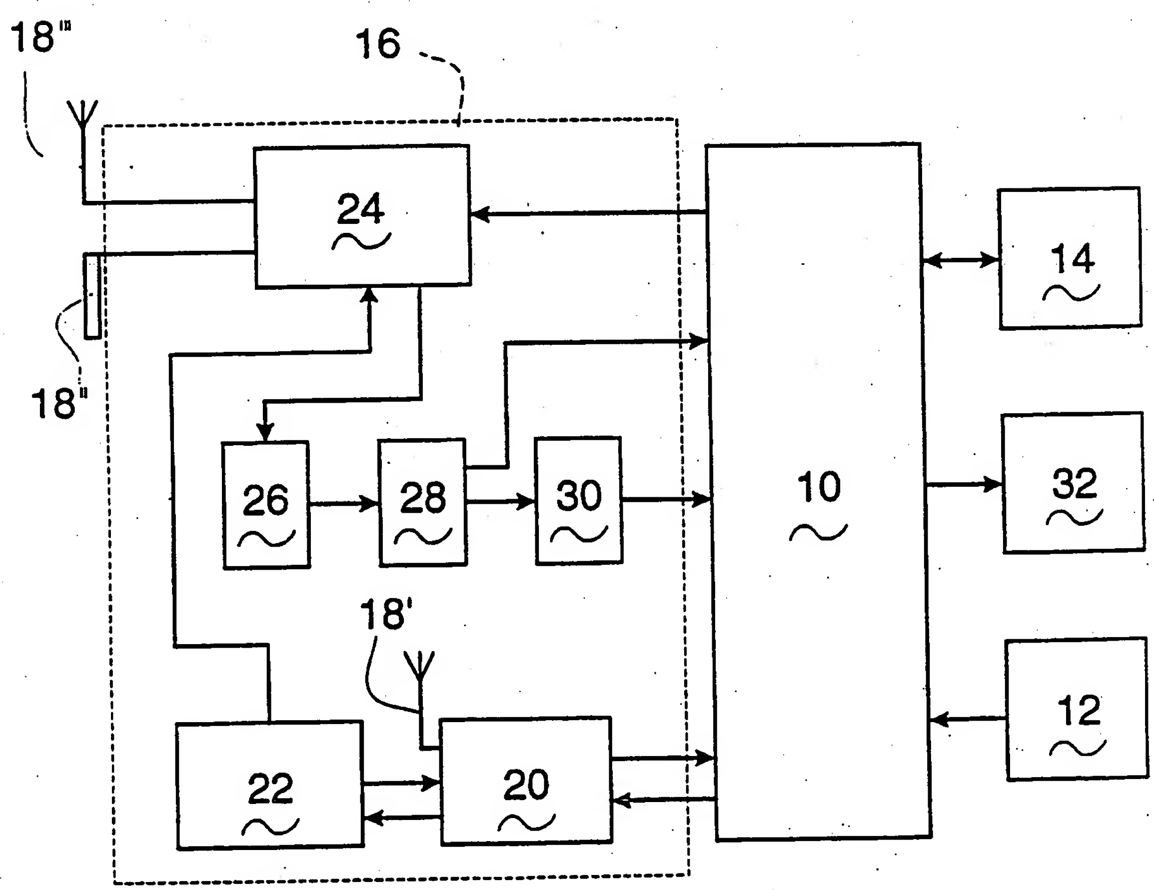

FIG. 2

FIG. 4a (A)

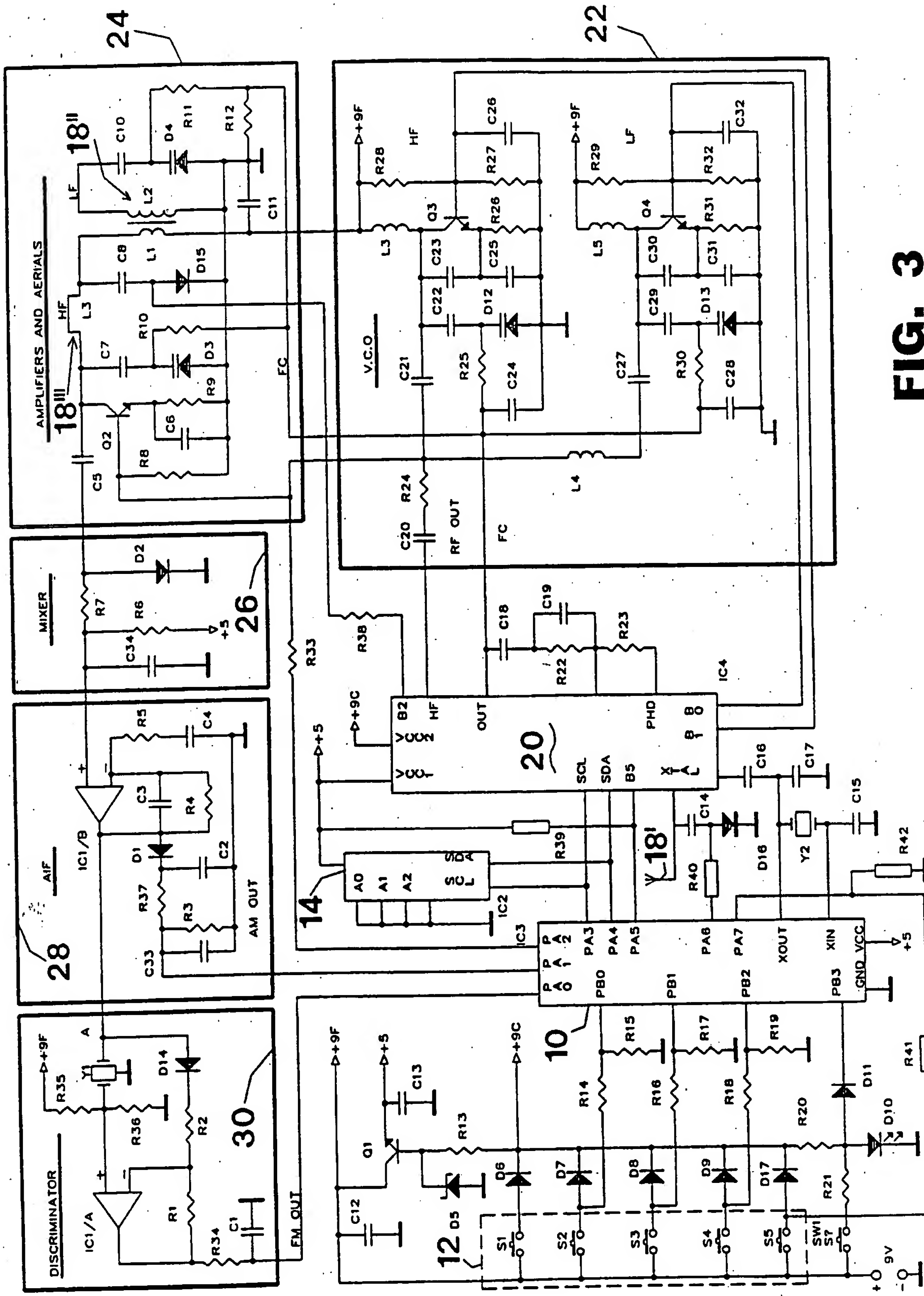
AMPLIFIERS AND AERIALS
V.C.O
MIXER
AIF
DISCRIMINATOR
AM OUT
FM OUT
RF OUT
24
22
26
28
30
20
14
10
12

FIG. 3

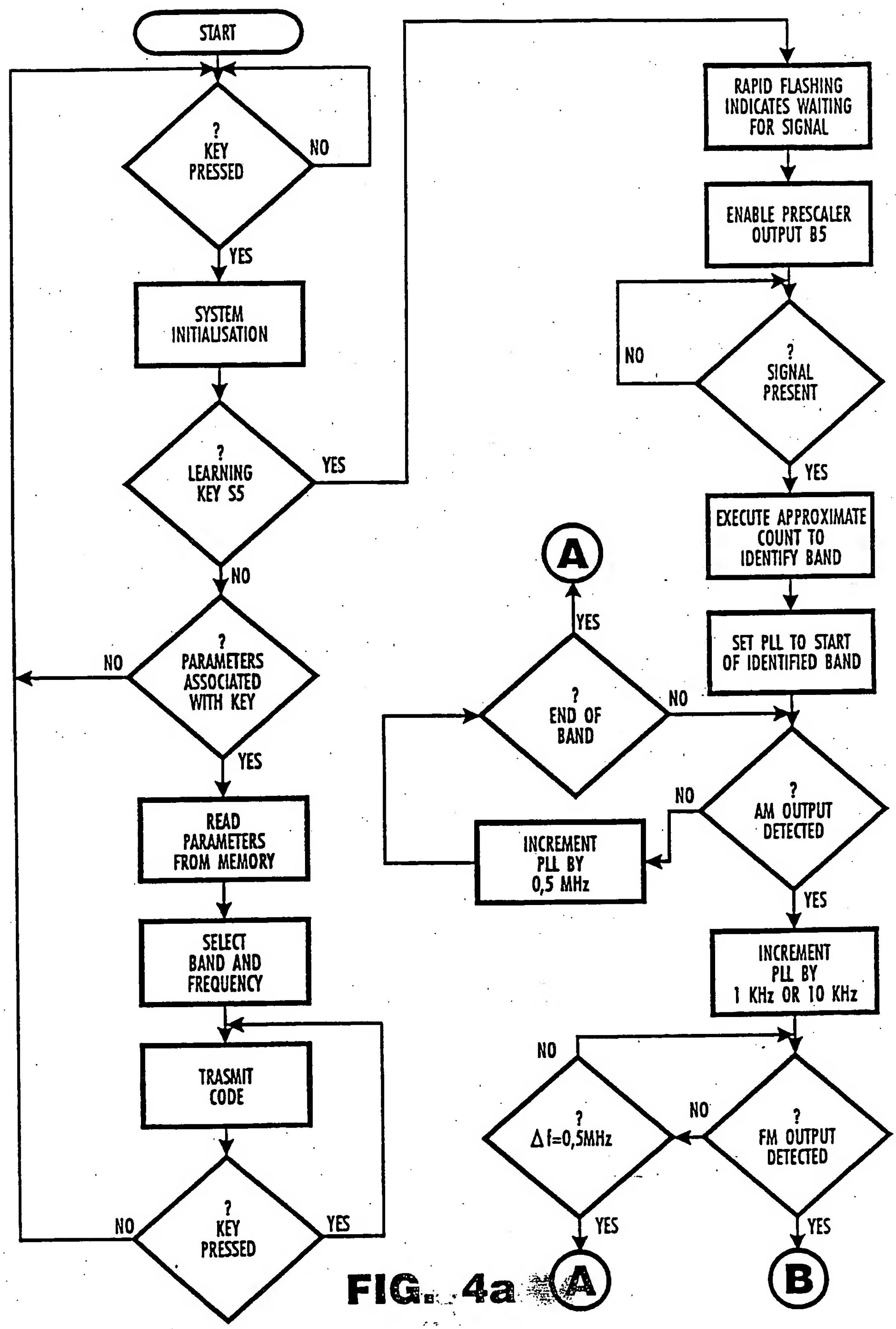
START
? KEY PRESSED
NO
YES
SYSTEM INITIALISATION
? LEARNING KEY S5
YES
NO
? PARAMETERS ASSOCIATED WITH KEY
NO
YES
READ PARAMETERS FROM MEMORY
SELECT BAND AND FREQUENCY
TRASMIT CODE
? KEY PRESSED
NO
YES
RAPID FLASHING INDICATES WAITING FOR SIGNAL
ENABLE PRESCALER OUTPUT B5
? SIGNAL PRESENT
NO
YES
EXECUTE APPROXIMATE COUNT TO IDENTIFY BAND
SET PLL TO START OF IDENTIFIED BAND
A
YES
? END OF BAND
NO
? AM OUTPUT DETECTED
NO
INCREMENT PLL BY 0,5 MHz
YES
INCREMENT PLL BY 1 KHz OR 10 KHz
NO
? Δf=0,5MHz
NO
? FM OUTPUT DETECTED
YES
YES
A
B

FIG. 4a

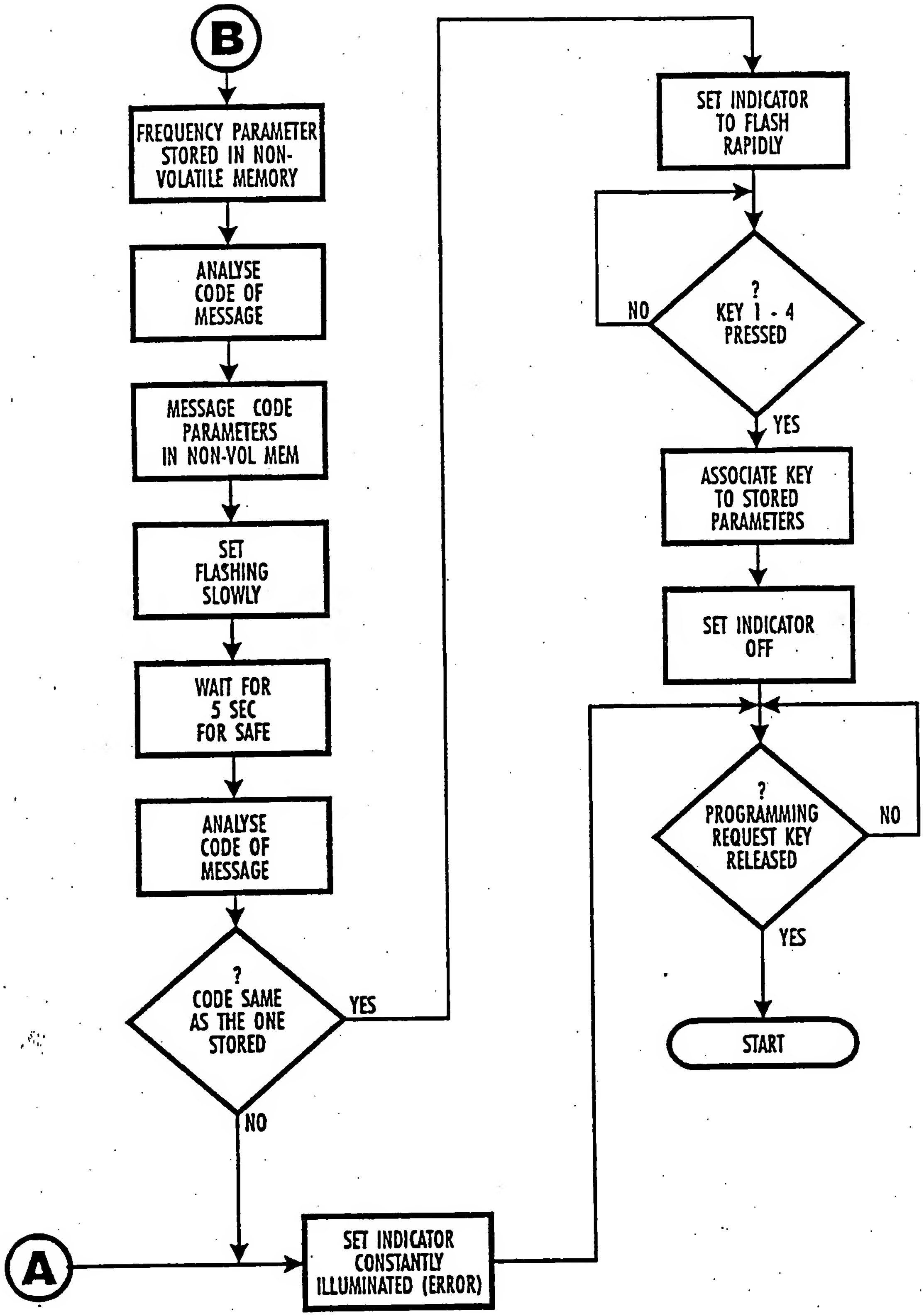
B
FREQUENCY PARAMETER STORED IN NON-VOLATILE MEMORY
ANALYSE CODE OF MESSAGE
MESSAGE CODE PARAMETERS IN NON-VOL MEM
SET FLASHING SLOWLY
WAIT FOR 5 SEC FOR SAFE
ANALYSE CODE OF MESSAGE
? CODE SAME AS THE ONE STORED
YES
NO
A
SET INDICATOR CONSTANTLY ILLUMINATED (ERROR)
SET INDICATOR TO FLASH RAPIDLY
? KEY 1 - 4 PRESSED
NO
YES
ASSOCIATE KEY TO STORED PARAMETERS
SET INDICATOR OFF
? PROGRAMMING REQUEST KEY RELEASED
NO
YES
START

FIG. 4b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IT 93/00080

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: G08C 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: G08C, H03J, H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG 125, 340, 350, 351

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5086298 (T. KATSU ET AL), 4 February 1992 (04.02.92), column 1, line 9 - column 8, line 51, figures 1-11 --	1-17
A	US, A, 4856081 (B.J. SMITH), 8 August 1989 (08.08.89), column 1, line 6 - column 21, line 47, figures 1-8 --	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" erlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 October 1993	08. 11. 93

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Roland Landström

SA 7006

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/93

International application No.

PCT/IT 93/00080

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5086298	04/02/92	JP-A- 1132280	24/05/89
		US-A- 4860095	22/08/89
		JP-A- 63290095	28/11/88
US-A- 4856081	08/08/89	EP-A- 0320067	14/06/89
		JP-A- 1191599	01/08/89